Urban vegetation effects on the spatial variability of temperature in the city center

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Background

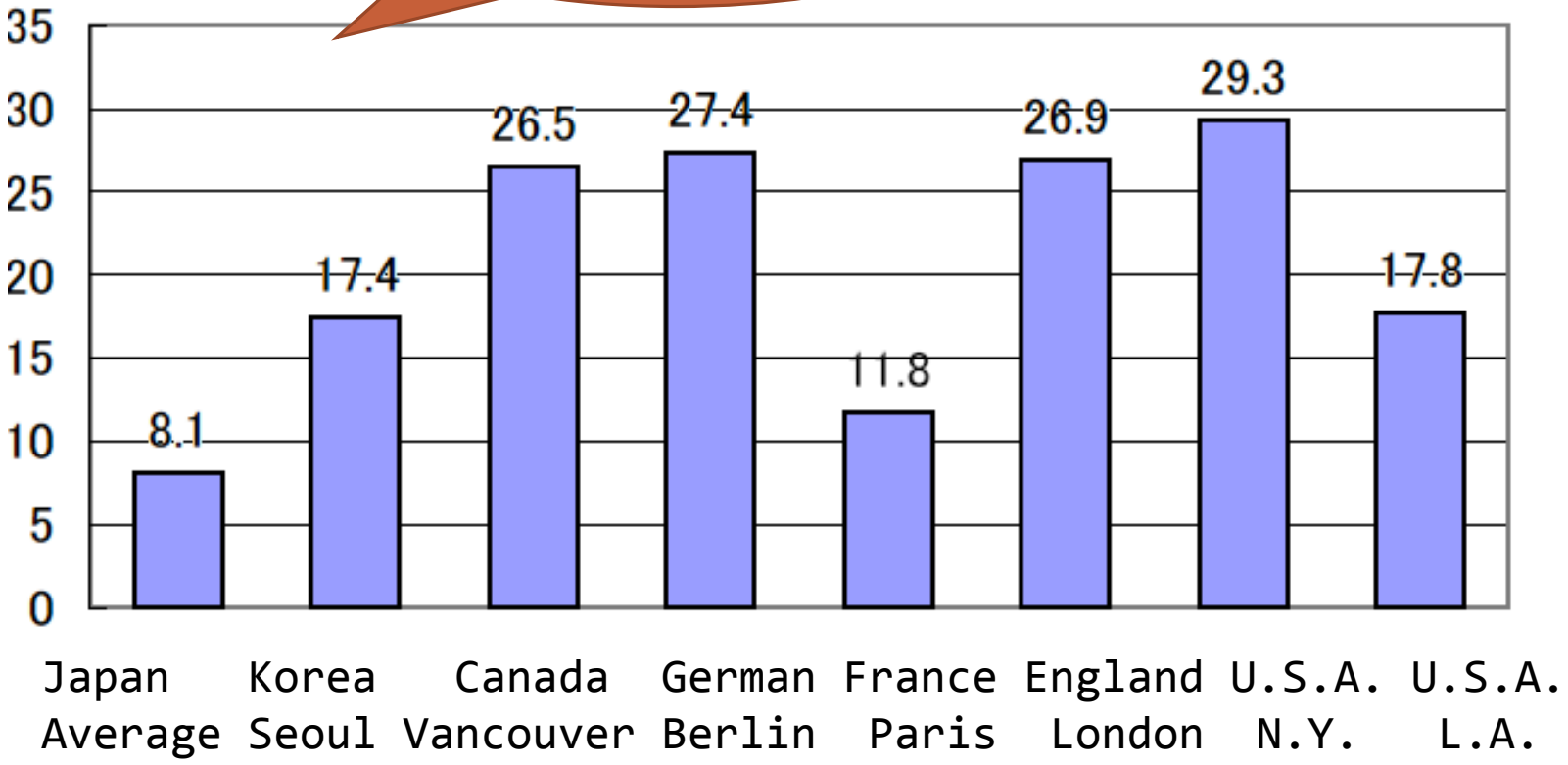
- Osaka city is one of the most hot and humid city in Japan
  - 34.5 degree North
- Osaka city has a large population and a few parks
  - 2.6 million people
  - Area 222 [km^2]
  - Park area 3.5[m^2/resident]

Population density 12,000/km^2

The park area per resident

[m²/resident]

Osaka City
3.5[m²/resident]



The purpose of this presentation…

- To survey current situation
  - Where is vegetation in Osaka City
  - How much vegetation in Osaka City

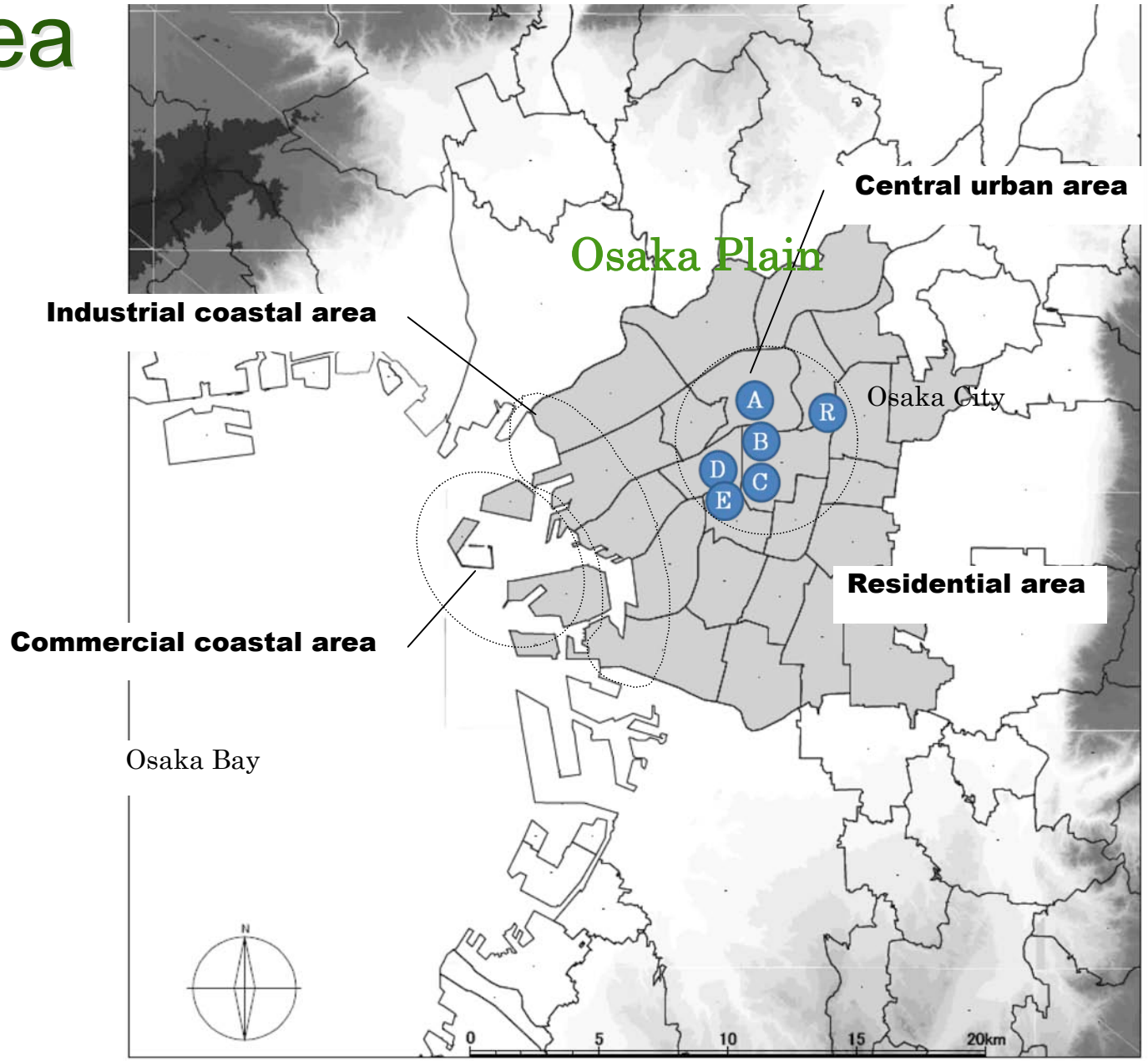
- To consider urban vegetation effects on spatial variability of temperature

Contents

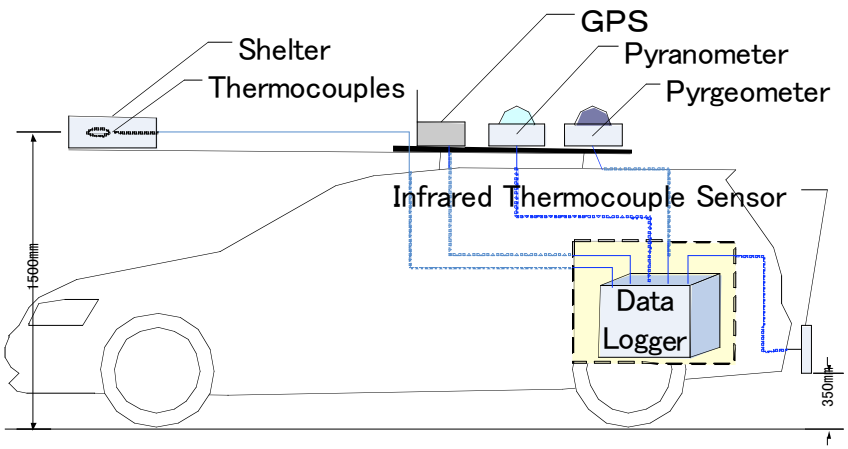
1. Study area and Equipment
2. The indexes of vegetation coverage
3. Discussion
   A) Distribution of vegetation coverage using the indexes
   B) Vegetation effects on temperature variability

1. STUDY AREA & EQUIPMENT

Study area

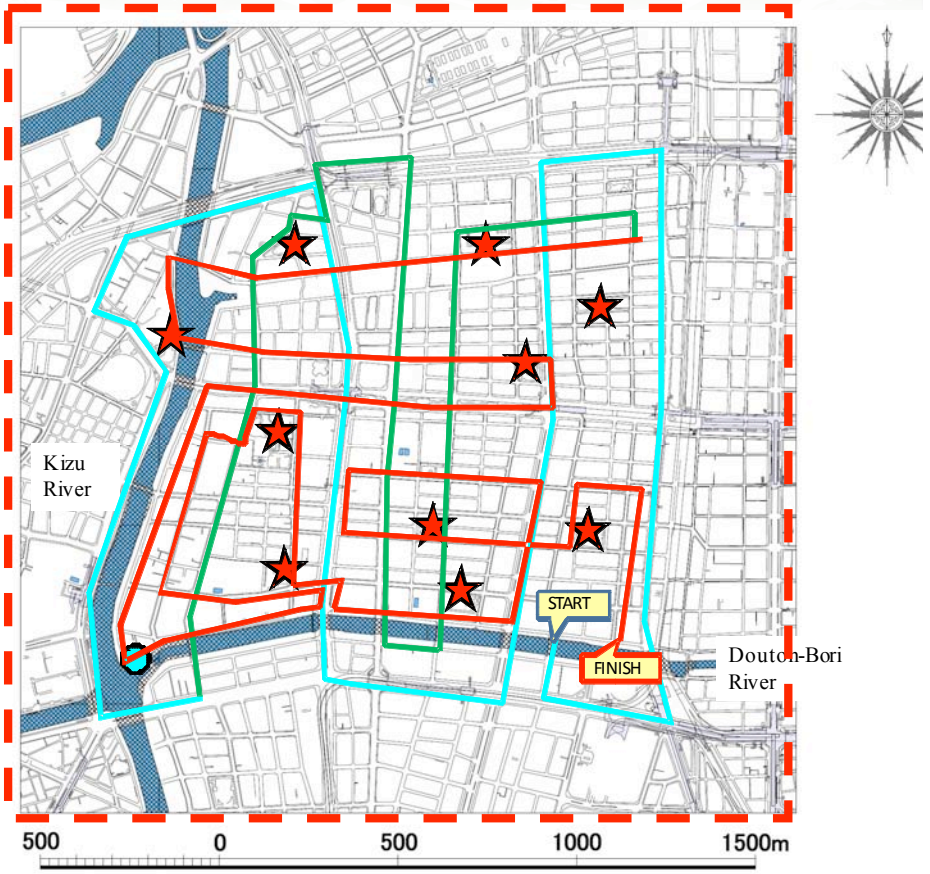

Central urban area
Osaka Plain
Industrial coastal area
Osaka City
A
B
C
D
E
R
Residential area
Commercial coastal area
Osaka Bay
N
0
5
10
15
20km

Observation area for temperature



the observing car equipped with a mobile measurement system

Observational Days
1) 2nd Aug. 2008
   - 14:30, 19:30, +4:00
2) 5th Aug. 2008
   - 14:30, +4:00



2. VEGETATION INDEX

Indexes of vegetation coverage

1. Coverage ratio

2. C index

They are calculated from 2 kinds of GIS dataset.

GIS dataset 1

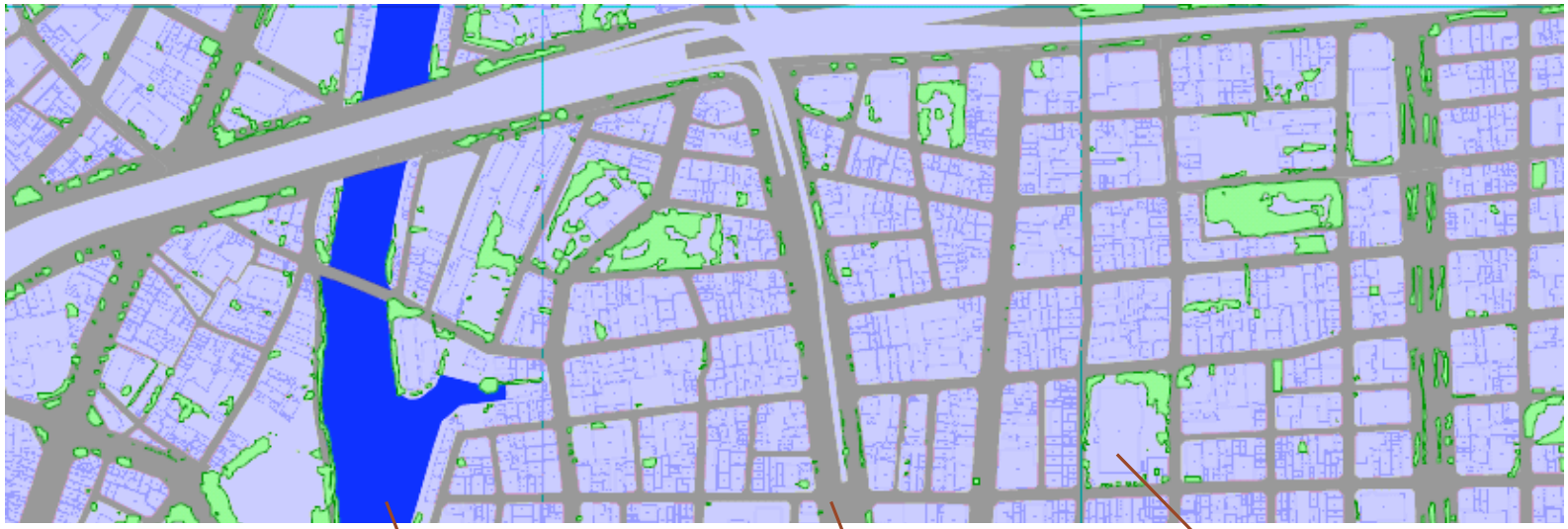
- The classification map
  - Photography image data of land cover was created from 1-meter resolution aerial photographs.

Pixels are classified into 5 types :
"grass field"
"trees or forest"
"productive green area"
"bare ground"
"water surface".

(excluding buildings and road surfaces)

GIS dataset 2

- The building map



Originally
Vector data

River

Road

Buildings

1) Vegetation Coverage Ratio

- The vegetation coverage ratio is counted in each 500-meter square

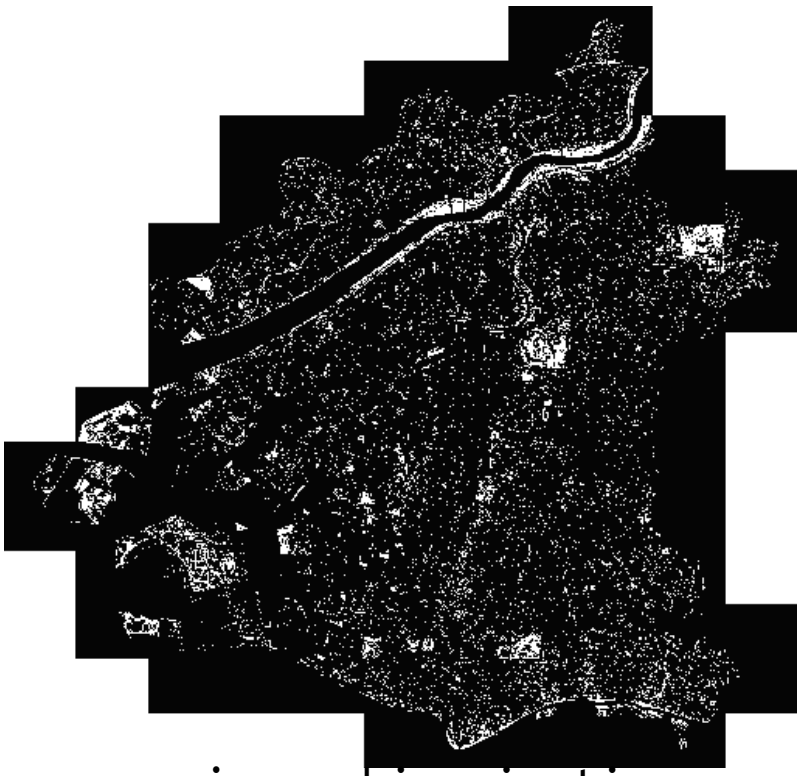
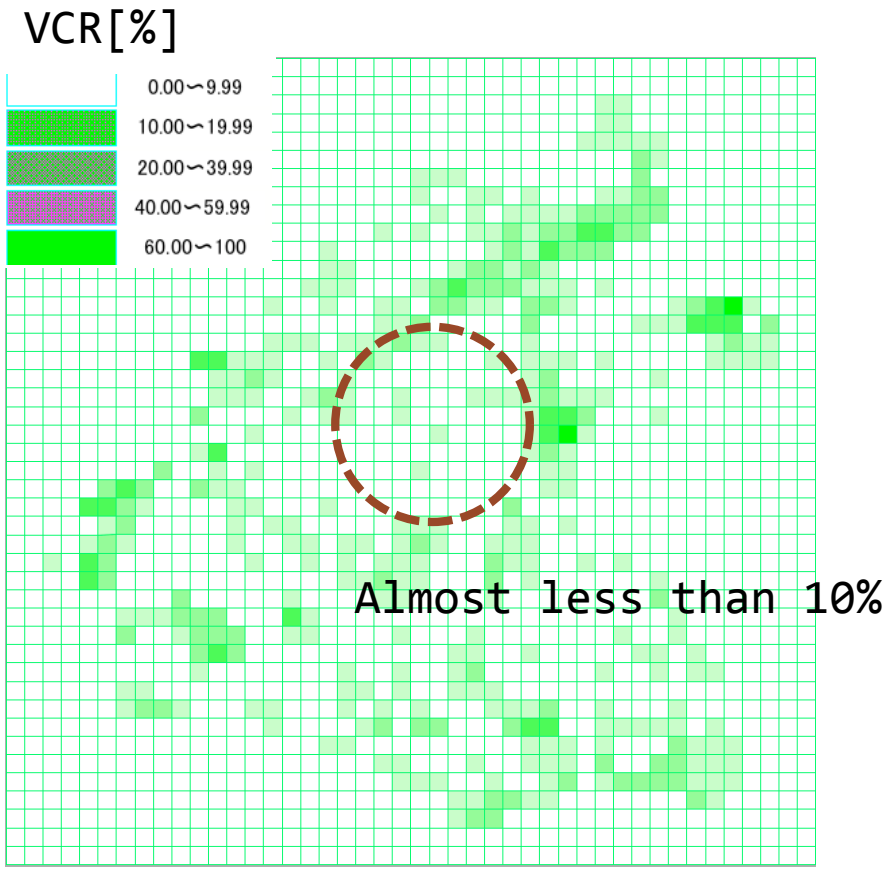


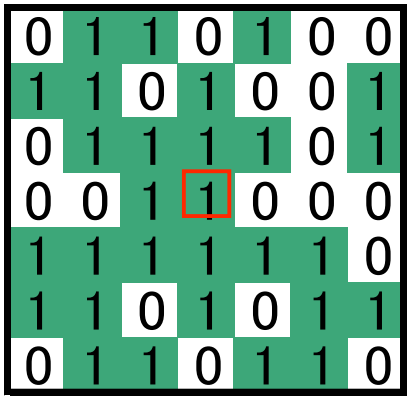
image binarization



2) C index

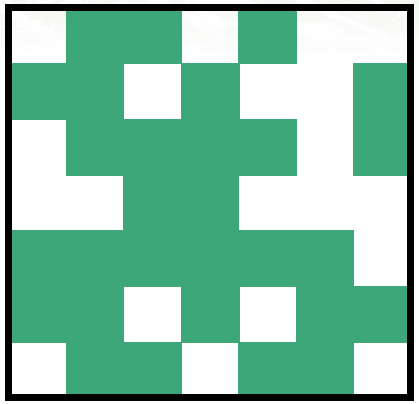
- The "C index" was suggested as an index of connectivity
  - (Kobayashi et al. 2001)

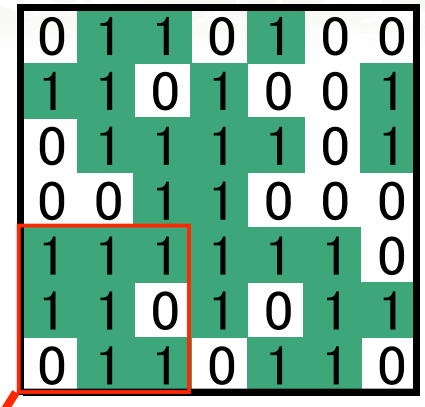
- Dataset: 10-meter resolution image of VCR

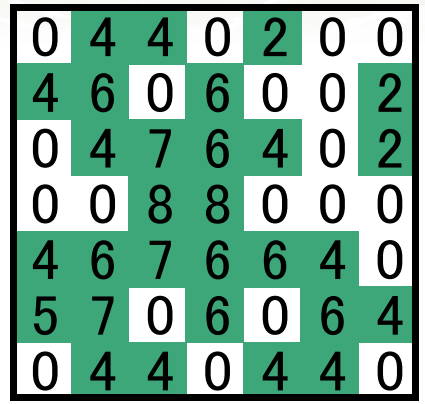


In reality, they can be fractions, 0<=VCR<=1)

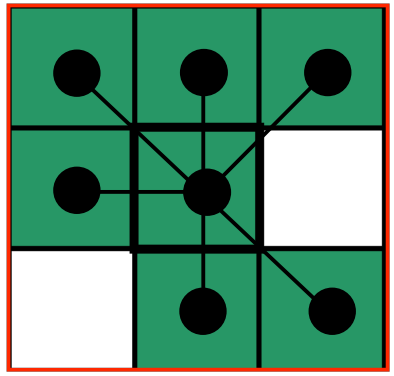
Procedure (1) calculating CN values

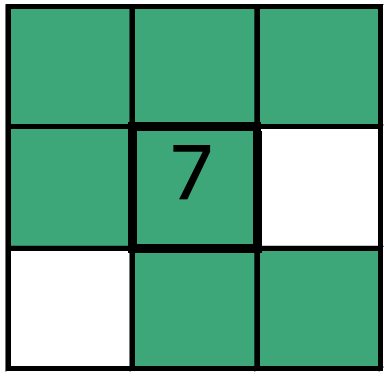






CN Value



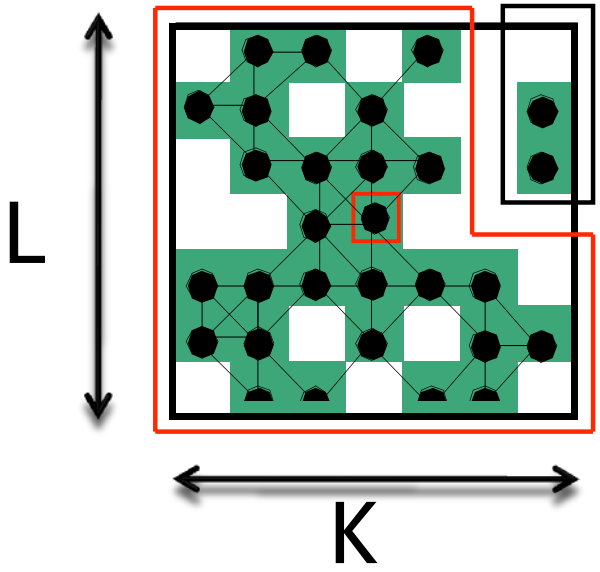


CN Value＝7

$$CN_{xy} = \sum_{i=x-1}^{x+1} \sum_{j=y-1}^{y+1} v_{ij}$$

$$\left(0 \le v \le 1, \quad 0 \le CN \le 9\right)$$

Procedure(2) deciding size of an evaluation area K by L



Procedure (3) C index

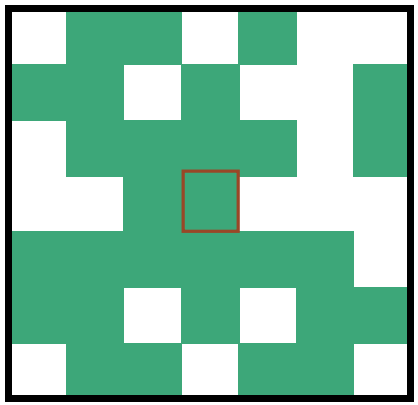
0	4	4	0	2	0	0
4	6	0	6	0	0	2
0	4	7	6	4	0	2
0	0	8	8	0	0	0
4	6	7	6	6	4	0
5	7	0	6	0	6	4
0	4	4	0	4	4	0

Total of CN Value＝154

0	1	1	0	1	0	0
1	1	0	1	0	0	1
0	1	1	1	1	0	1
0	0	1	1	0	0	0
1	1	1	1	1	1	0
1	1	0	1	0	1	1
0	1	1	0	1	1	0

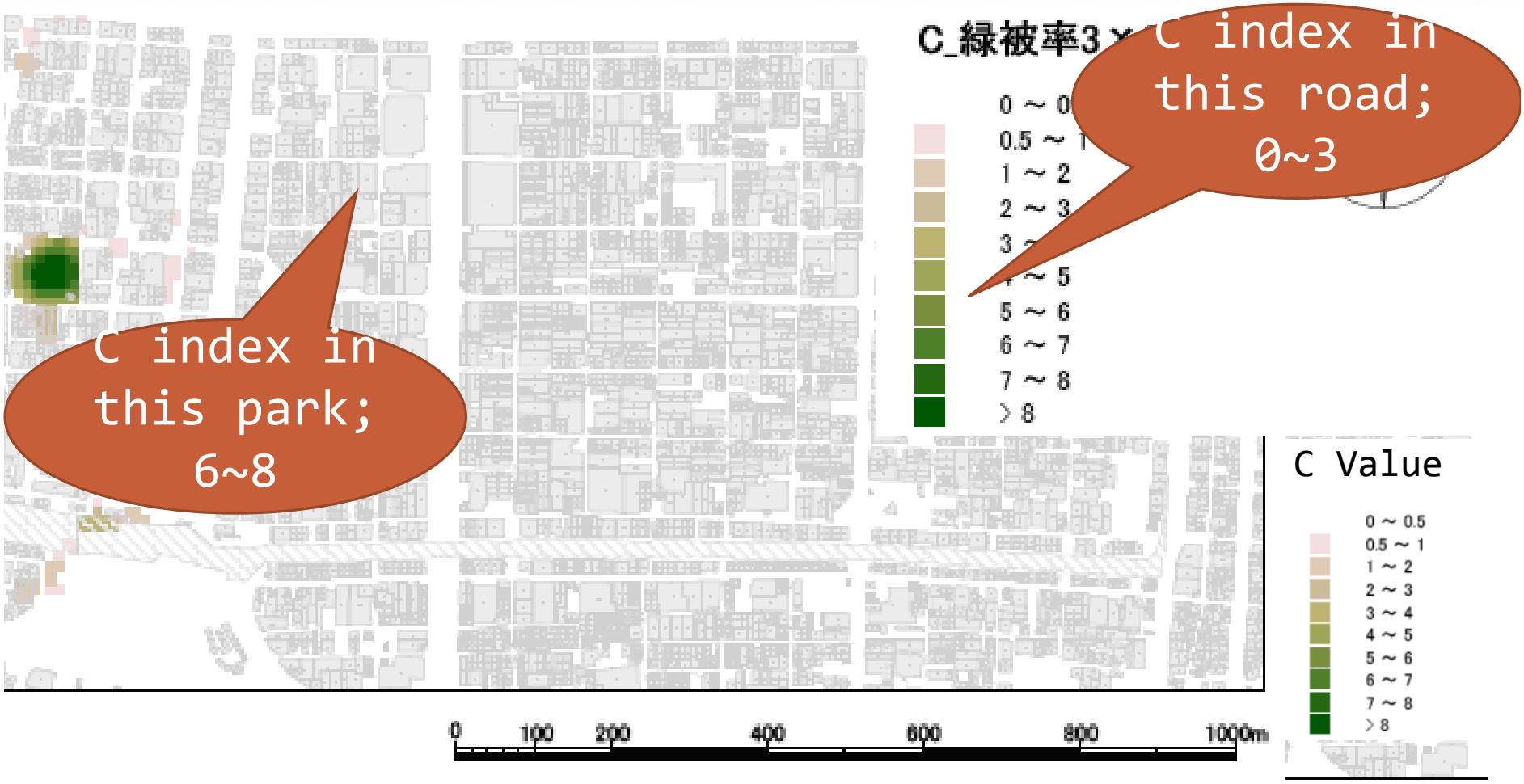
Number of “1”＝29

C index＝154/29＝5.3



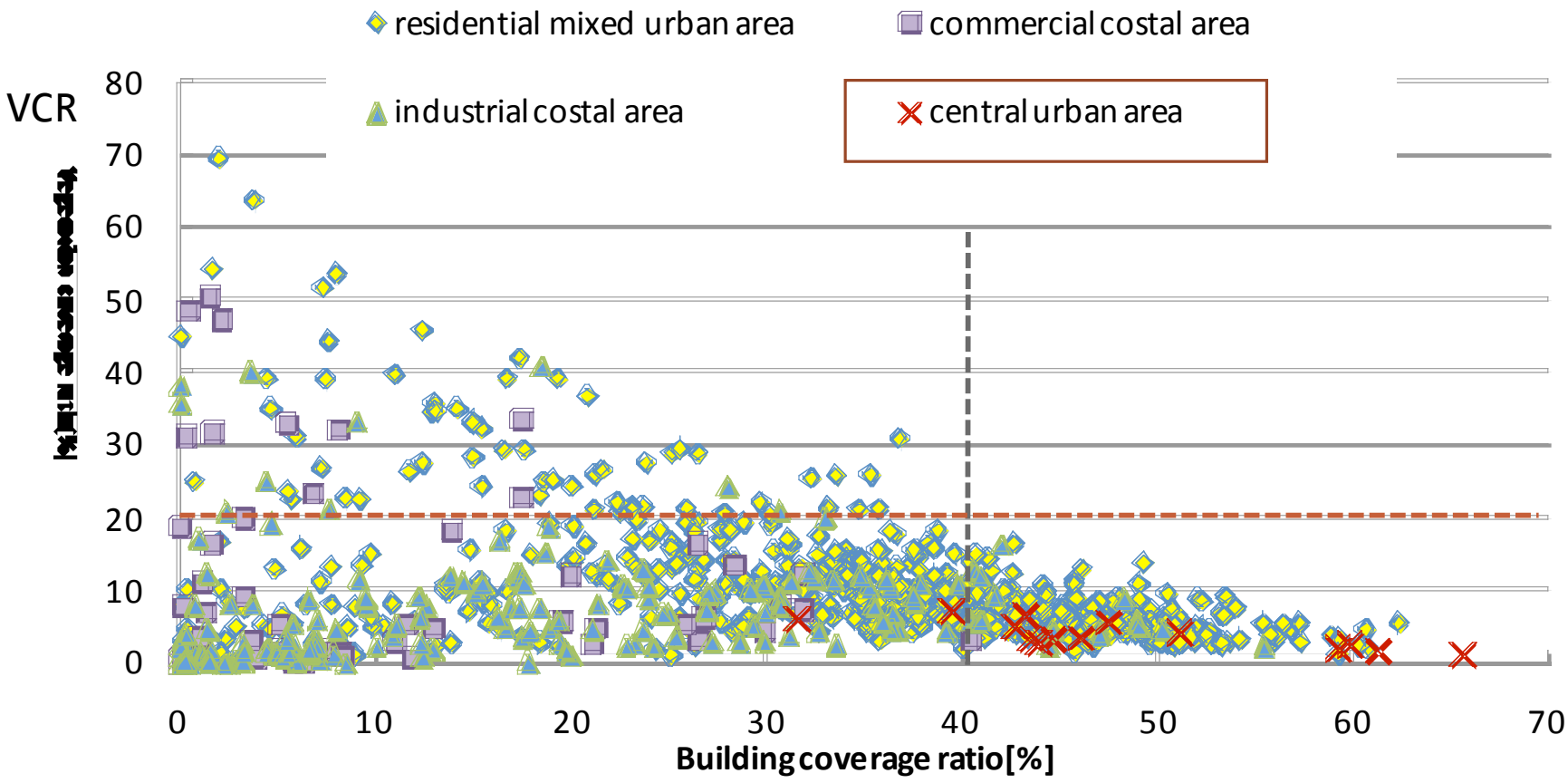
The average of CN values

Distribution of C index



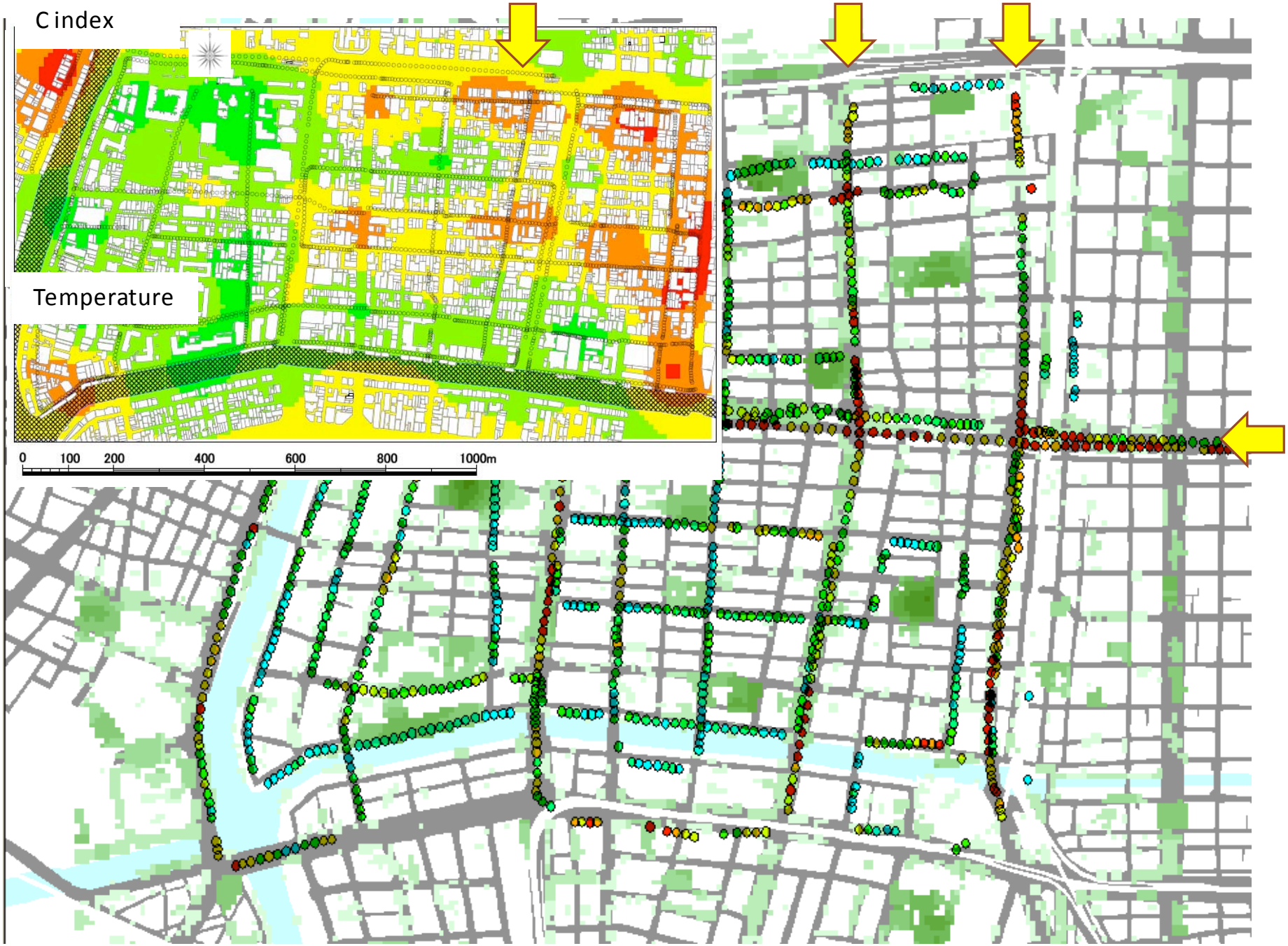
3. VEGETATION DISTRIBUTION

Vegetation Coverage Ratio

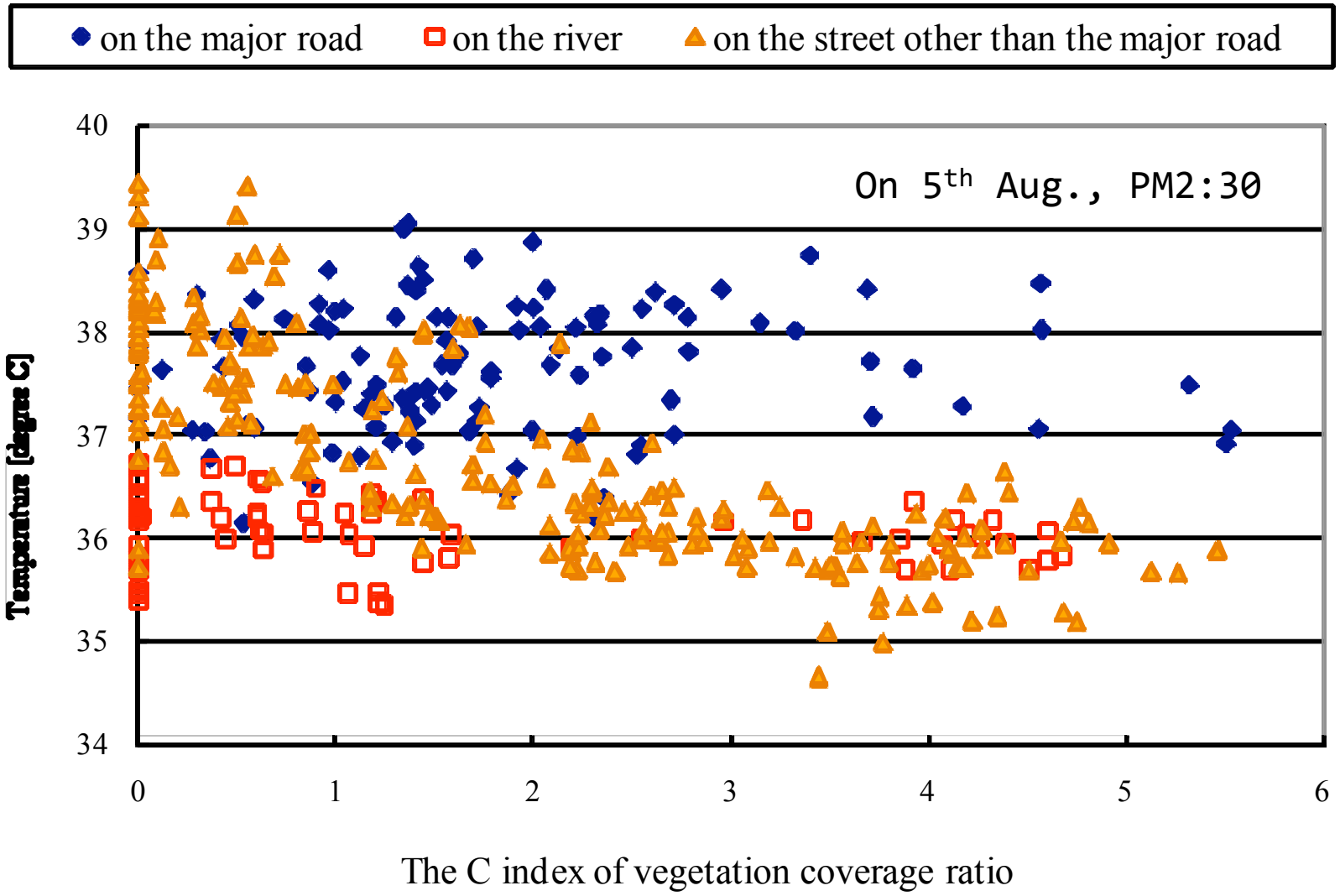


4. VEGETATION EFFECTS

<Urban Central Area>



Relationship between C index and Temperature



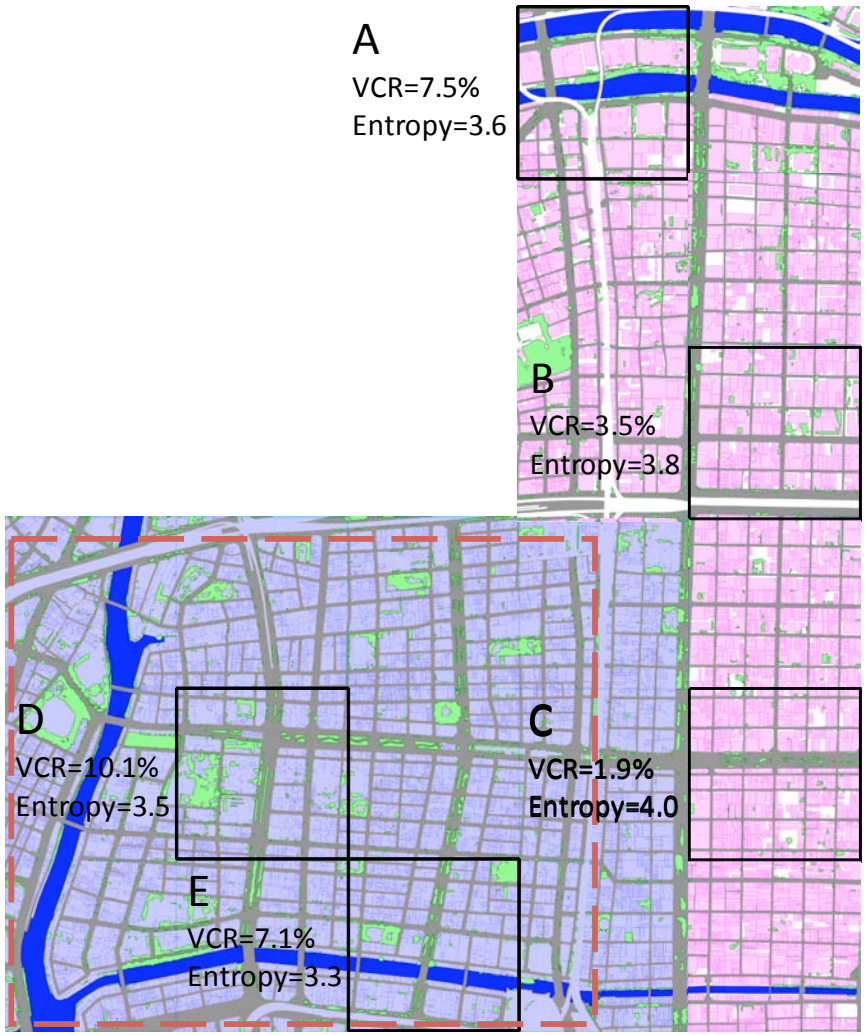
Conclusion

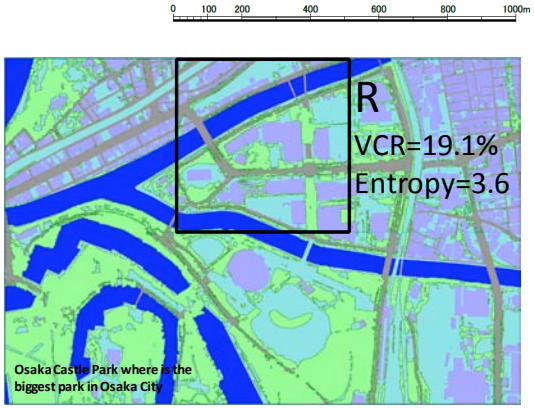
- It is found that the *C* index of the cells around the urban parks is assigned a high score.
- There is a negative correlation between the temperature on the streets other than the major roads and the *C* index.
- Continuity of urban vegetation coverage was confirmed to keep temperatures at a relatively low level.

THANK YOU

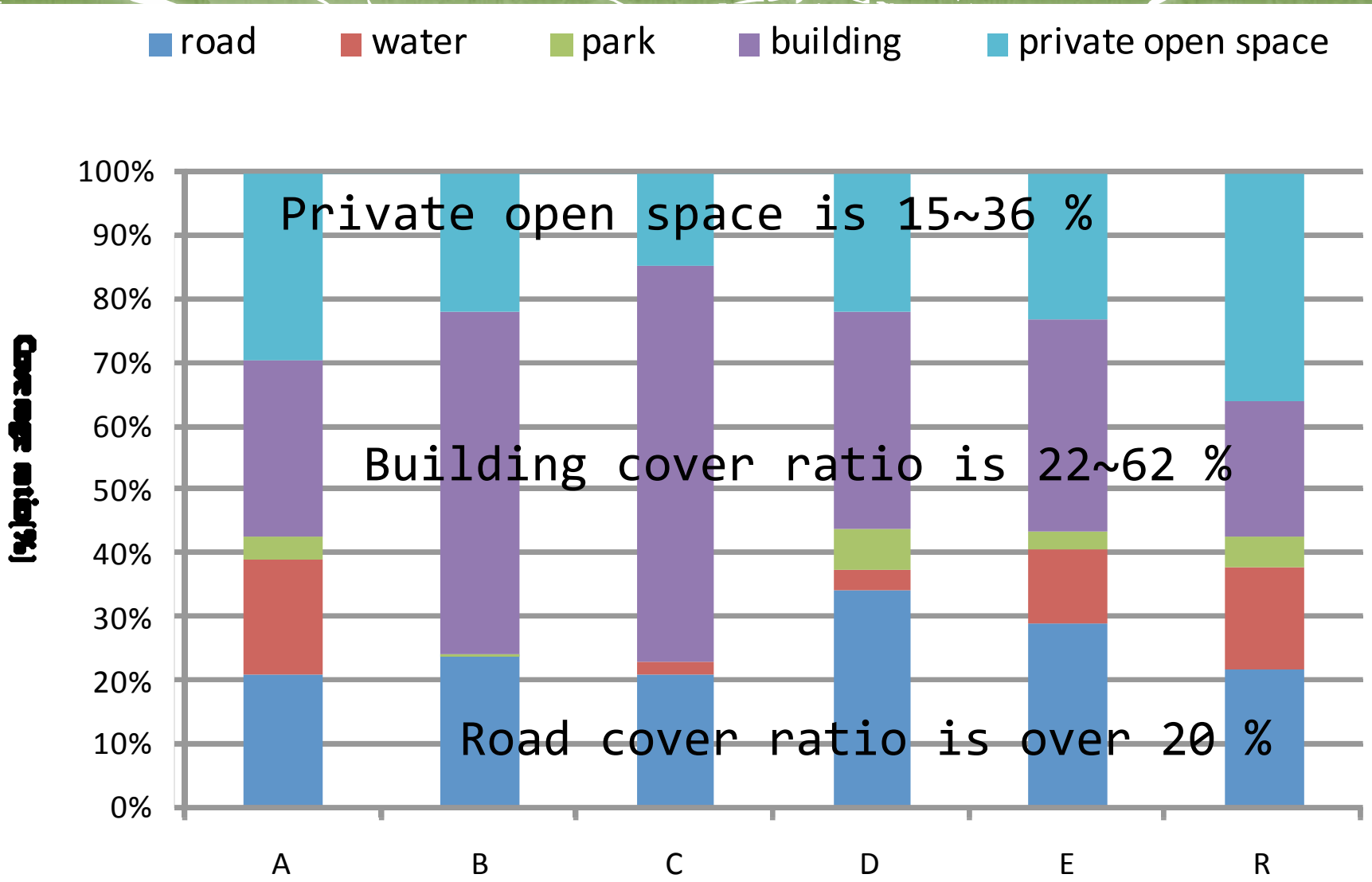
Details and Findings

Survey area in detail

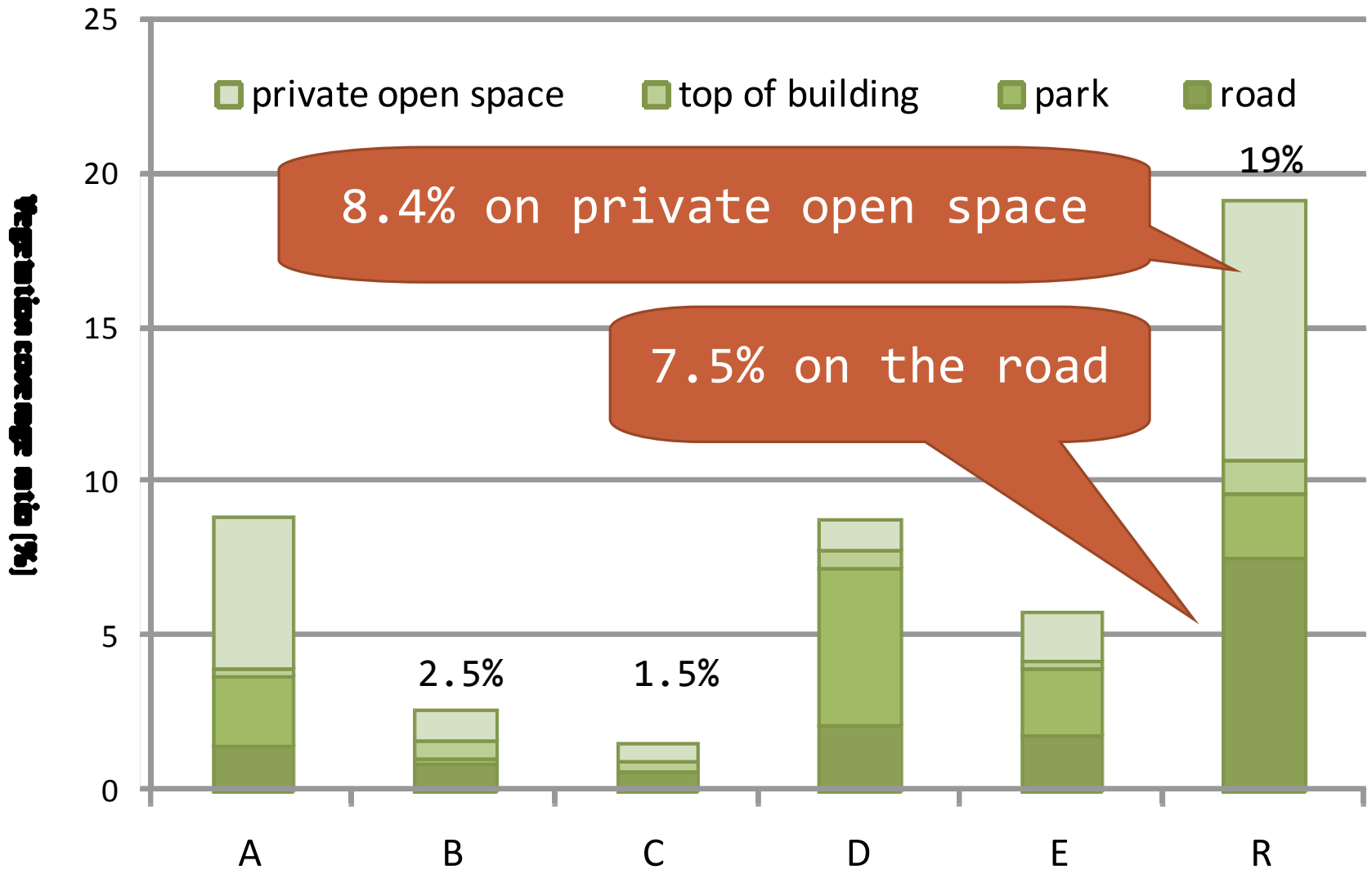




Survey area in detail



Where is vegetation coverage



Findings 1

- The redevelopment zone has succeeded from a standpoint of increasing the vegetation coverage ratio.

Findings 2

- The vegetation coverage ratio of the modern business zones is found to be less than 3% because of the high density of buildings, on the order of 54% - 62%.

- Most roads have very low vegetation coverage in typical business zones, where there is room for increasing the number of roadside trees.

What is an effective first step ?

- It is important that the sunny side of street should be covered with roadside trees which connect to the urban park as soon as possible.